

# Hot Iron

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site is also at  
[www.walfordelectronics.co.uk](http://www.walfordelectronics.co.uk)

## Kit Developments

Much of the last three months has been taken up with non-radio matters so not quite as much to report as I would have liked. The **Cary** is now available after quite extensive development (see later) - the wide range of bands proved to be rather more of a challenge than I anticipated!

I have even started on building the revised **Minster Mk 2** (right)! I hear some faint signal in the noise ... 'about time to'! The RX text is mostly written and I will soon finish building it; & then add the TX. It will use the earlier RF Extras kit to convert it to any 3 bands, with options for AGC, CW etc. G3PCJ

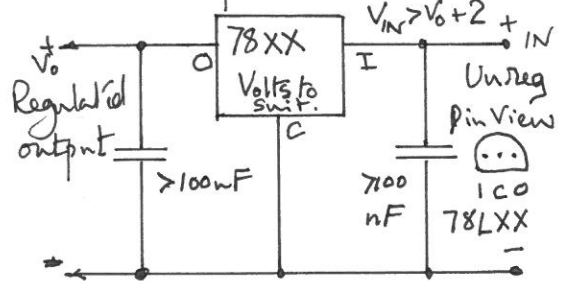
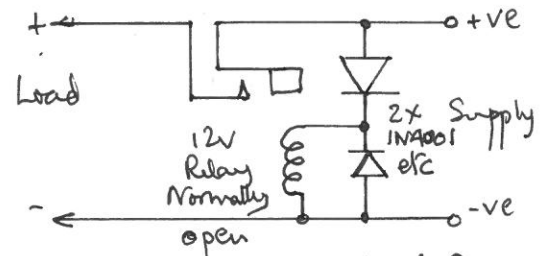
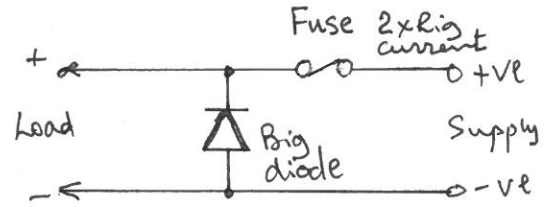
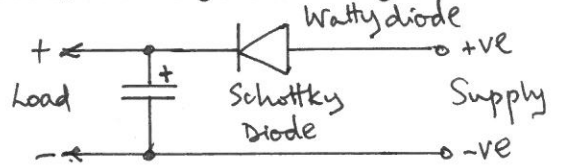


**Hot Iron** is a quarterly subscription newsletter for members of the Construction Club. Membership costs £7 per year with the first issue for each year appearing in September. Those people joining later in the year will be sent the earlier issues for that year. Membership is open to all and articles or questions or comments or notes about any aspect of electronics—principally on amateur radio related topics— is very welcome. Notes on member's experience building their own gear, from kits or otherwise is most interesting to other constructors. To keep it interesting, your thoughts and ideas are required please! For membership, I only need your name and address and subscription. Send it or any other suggestions to Tim Walford, Walford Electronics, Upton Bridge Farm, Long Sutton, Langport, Somerset TA10 9NJ © G3PCJ

## Supply Miscellany!

It is some while since we mentioned power supply aspects, so some general background info!

**Reverse Supply Protection** There three basic approaches as shown on the right. Firstly a diode in series with the incoming supply line. Gives full protection but drops between about 0.4 and 0.8 volts depending on type. Ordinary Si diodes (1N4000 series) drop about 0.6v up depending on current. Better are Schottky diodes which are down at the 0.3 v up level. I use 21DQ06 or SB330 devices, the 1N5817 series are also suitable but a bit physically larger. If heavy transitory load currents (power audio) can occur, needs heavy decoupling! The next scheme is a big power diode across the supply (after a fuse) - the diode conducts when the supply is reversed and blows the fuse! Correctly installed MOSFET RF power output stages like an IRF510 can act as a diode so you don't need an extra one! Problem - this scheme is not sufficiently quick to always prevent damage. The best solution is a relay which only turns on when the supply is the right way round!

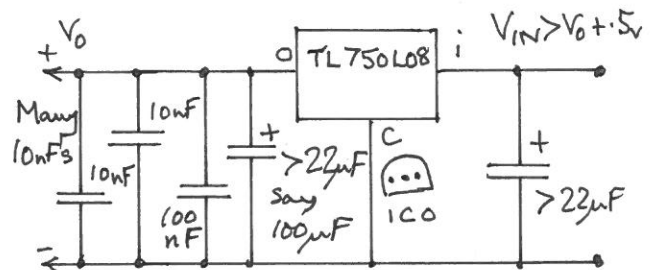
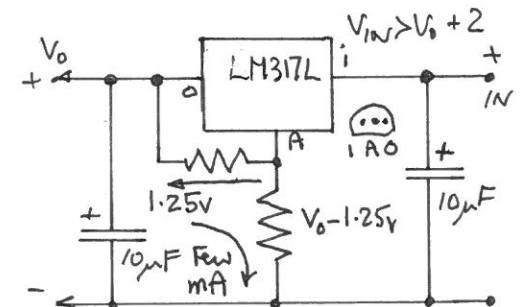


**Fixed Regulators** The common and cheap 78 series devices are excellent for general purpose use. The TO220 style devices are usually rated at 1Amp with the small ones at 100 mA. There are many fixed voltages available - commonly 5, 8, 9,12 and 15v in both positive and negative versions. They are supposed to need decoupling by at least 100 nF on both input and output but I have not yet had a problem when omitted on a bench test lash-up! The input range is usually from 2 volts above the desired output up to about 35v. The need for 2 volts more than you want is their main drawback unless you need very high regulation against variation in load or incoming volts.

**Adjustable regulators** The LM317 series provide better regulation (change in output voltage) as either the load or the incoming volts are varied. This makes them especially suitable (or even mandatory!) as the source for tuning voltages used with varactor tuning diodes. Again there are high power T versions rated at an Amp but the small ones are 100 mA. They also need an incoming supply at least 2 volts (up to 35v) above the desired output. They need 2 resistors to set the internal feedback voltage to 1.25v.

**Low drop out regulators** These devices do NOT need the 2 volts headroom between in and out voltages. Often the difference can be down to 0.3 volts at full load. The LM2930-T8 devices are now expensive so I am using the 100 mA 8v TL750L08 in small rigs. These must have at least 22 uF of output decoupling otherwise they oscillate!

**Decoupling** If in any doubt, add plenty! Almost all circuits will benefit from too much! Use 10 nF disc caps spread all over an RF board, then parallel with 100 nF polyester somewhere and maybe up to 100 uF electrolytic if feeding an audio output device. G3PCJ



10nF's all over PCB for good RF decoupling!

©G3PCJ

## 'Widebanding' a 40m Kilmot by Steve Davies MW0KST

I thoroughly enjoy building, testing, modifying and generally tinkering with Tim's kits. After getting them working, experimenting is probably the most fun. In fact several extra mysterious holes can often be found in the kit PCBs – maybe just for this purpose?

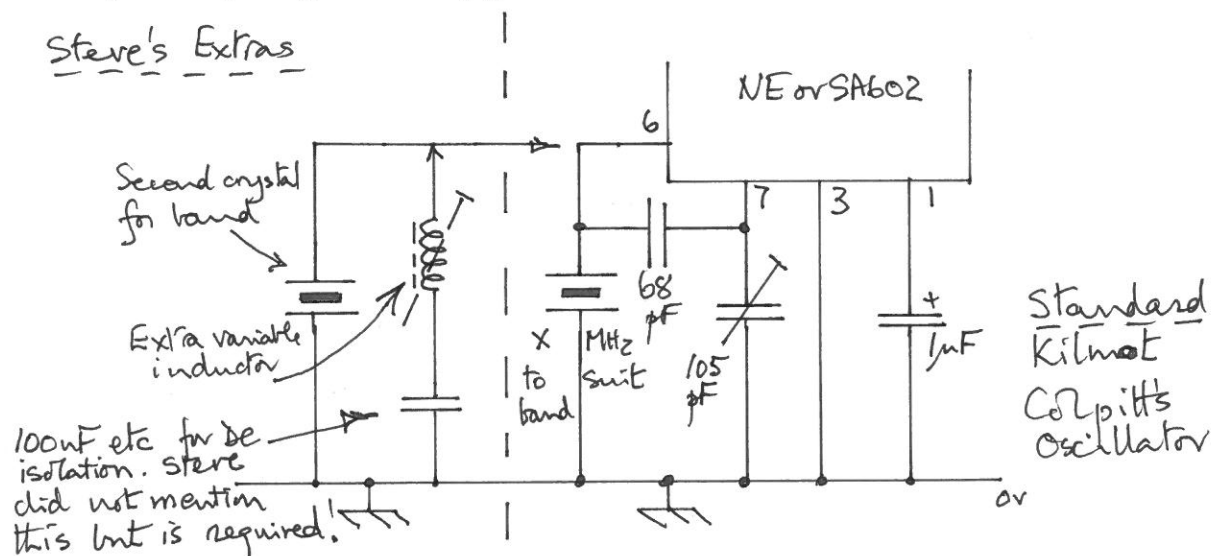
My most recent 'build' is the little Kilmot VXO DSB transmitter for 40m. From the start I planned to adapt it for use on both 40m and 80m. The idea was to simply switch the 40m crystal over to the 80m ceramic resonator, at the same time switching in an 80m low pass filter. However, probably like a lot of people, I wanted a little more coverage on 40m than could be achieved using the single crystal. I'd read about the "super VXO" and various articles in publications such as 'Sprat' about how to increase the pulling range of a crystal VFO. This would retain the advance of excellent stability while providing much more useful band coverage.

I started my little experiment by adding a parallel 40m crystal the same frequency as the original in the kit. The result was disappointing, with only an extra 2 or so KHz more bandwidth. I then added an inductor between the pair of crystals and earth. The inductor used was a Toko 3336 left over from a previous kit. This seemed to work surprisingly well. With adjustment of the inductor, I was able to tune the VFO from the crystal frequency down about 30 or more KHz.

A bit more playing with the new 'widebanded' version of my Kilmot revealed that the oscillator would not start when switching on if the VFO was set near the crystal frequency. I also noted that on some (but not all) occasions, going into transmit near the crystal frequency caused the oscillator to stop.

Adjusting the inductor partly cured the problem. I set the VFO frequency near the crystal frequency and adjusted the inductor while switching on an off, soon finding the point at which the VFO reliably started on each occasion. The downside of this adjustment was that the usable bandwidth was reduced to about 10 kHz. Still, not bad for a very simple mod. involving the addition of two junkbox components.

If anyone knows how to achieve the larger VXO range whilst maintaining VFO stability near the crystal frequency, I'd be very grateful to hear from them!



Comment from G3PCJ. The nominal inductance of the 3336 TOKO is about 45 uH; my impression is this is a bit large for pulling most HF crystals - I think 10 uH is more typical. I don't have much experience except at 6 MHz (for a Colpitts CIO), where adding 10 uH directly across the crystal allows it be pulled down easily to 5998.5 KHz. Without the 10 uH, it will easily go up to 6001.5 KHz.

## Ideas for 3 band rigs

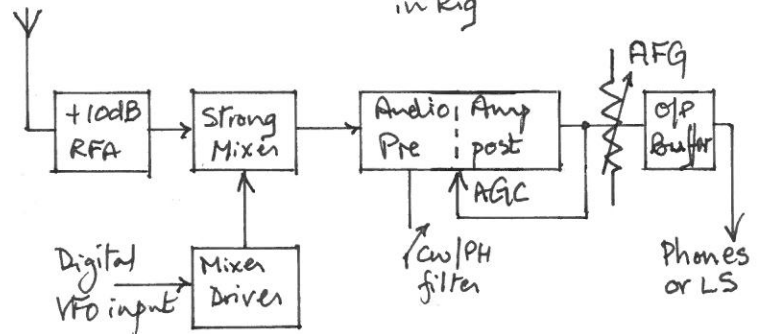
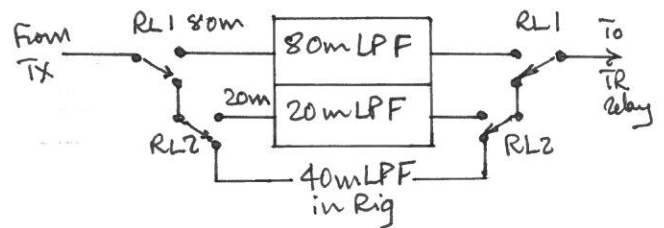
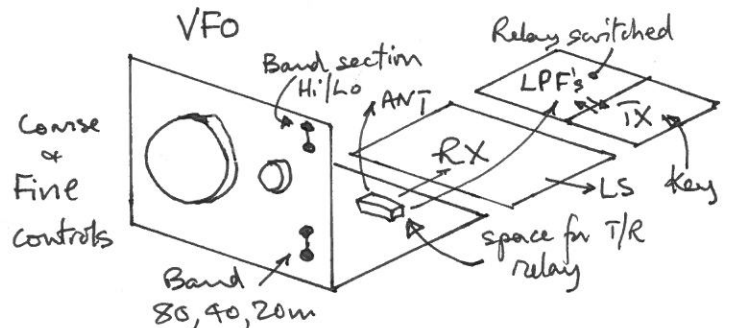
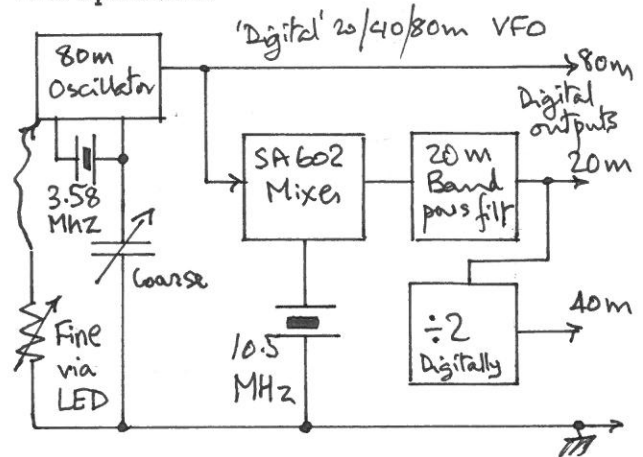
The ease with which the Cary regen (see next page) can be made into a 3 band RX has made me ponder different approaches for a 3 band CW transmitter. I started by considering 80m using a ceramic resonator for the CW section to give limited VFO operation without the problems of chirp when a 'normal' VFO and TX output stage are on same frequency. How to get up to 40 and 20m? Doubling (twice) would magnify any drift, so no good. Mix with a 3.5 MHz crystal source for 40m is possible but does not solve 20m! That needs a 10.5 MHz crystal - maybe use third harmonic of the 3.5 one - no, too complex. Consider separate crystals for each band - however soundings of potential customers indicated they wanted proper VFO operation!

So back to a scheme that I had used in the Locking some years ago (right). This uses an 80m ceramic resonator as the basic VFO. For 20m this is mixed with a 10.5 MHz crystal (I have plenty), passed through a 20m BPF and then digitised into a 5 volt logic signal. This can then be easily divided by two for 40m. This arrangement would provide 0-5v logic output signals for 20, 40 or 80m with all three bands sharing the same bottom band edge tuning spot. A single tuning spot would also be shared by all three nominal CW QRP 'frequencies' - 3.56, 7.03 and 14.06 MHz!

What sort of physical format should this be given? Somebody had suggested a 'universal' VFO which led to the idea of this gadget being used to drive a TX and/or a direct conversion RX. The VFO section could be in the small upright format (like Yeo or Cary), with TX and or RX behind. See rough outline on right! Band selection would be done by DC signals from a centre off toggle switch.

As it happens the existing Kilton CW TX, will work on any of these three bands provided the low pass filters are suitable. It can also be easily driven with logic signals from an external VFO. The existing design allows for connection of a Linear and these pads can be used to add a pair of relay controlled low pass filters for 20 and 80m with the Kilton's normal LPF set for 40m as shown right. (This broad approach might also work for the DSB phone Kilmot.)

The last element is a wide band DC RX using the same VFO! It would need RIT but that can be applied to a Fine tuning pot easily. I plan to try out a 'strong' partially balanced mixer that might avoid the considerable complication of RF band pass filters for each band. Hopefully the use of a resonant AMU might just provide enough out of band rejection. A low gain broadband RF amp might be a sensible addition to stop unwanted LO radiation. The mixer would be followed by a grounded base audio amp, filtering for phone or CW and further audio stages for driving phones or a small speaker. It might be worth considering AGC for this rig too. Any comments? Tim

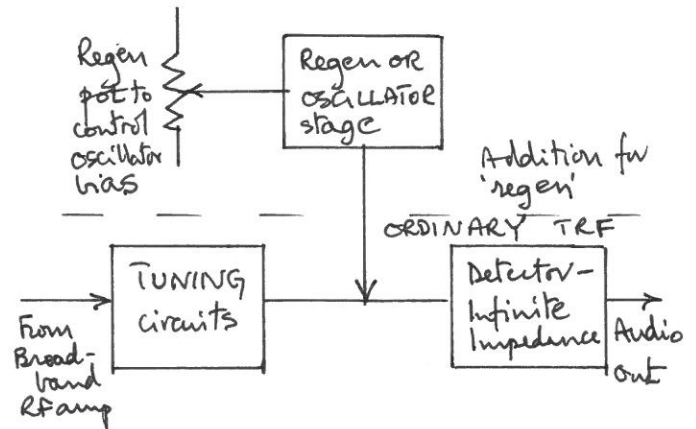


Wide band RX Concept

© G3PCJ

## Development of the Cary

I had thought that it was all sorted! However, the thorough testing by the two Steves (MW0KST and G0FUW) showed it needed more work! The problem is the desired wide frequency range - MW (single band) for novices to 20m in its 3 band form - 1 MHz to 15 MHz! The diagram right shows the heart of a TRF set with a resonant circuit feeding a detector. It is turned into a regenerative TRF by making it capable of oscillation, and because transistors are so cheap compared to valves, it is now best to use a separate oscillator stage. The frequency of oscillation is determined by the main tuned circuit. The stage is controlled to be either just NOT quite oscillating for AM, or to be JUST oscillating to provide the LO for CW or SSB use, by careful adjustment of its bias conditions.



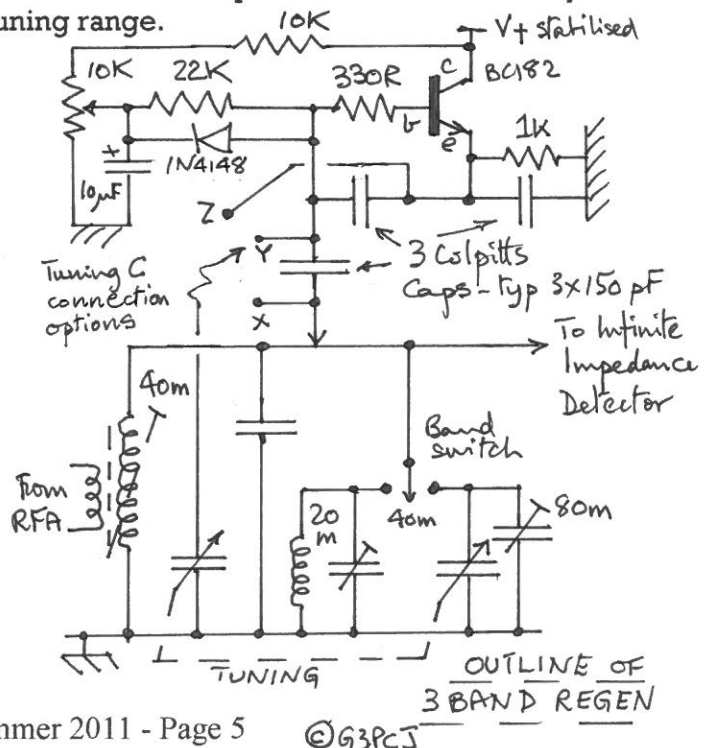
Having a separate oscillator (or regen stage) works well and gives less interaction between the controls for tuning and regen than was typical with a single valve for both functions. At the very low frequency end, I found it necessary to keep the impedances high, otherwise the regen stage would not oscillate. But this then led to squegging when the resonator was altered for 40m! Squegging is what happens intentionally in a super-regen detector where oscillations build up repetitively to some level and then cease, which usually causes a rough sounding hash in the audio. Not good for CW/SSB where a steady condition is needed, with it just into oscillation! This was eventually cured by a change to the Colpitts oscillator configuration (with lower emitter resistor for HF) instead of the earlier Hartley arrangement. This also has the benefit of swamping the regen transistor device capacitance, which changes with bias, by the Colpitts capacitors; this leads to less shift in frequency as the regen pot is altered.

The final hurdle was an unexpected VHF oscillation! This is quite a common problem in emitter follower circuits because they can look like a Colpitts oscillator if they are feeding a capacitive load! The cure is a base stopper resistor which reduces the gain at VHF but is transparent at HF! Finally, the resonating capacitor values needed manipulation to minimise the number of different values in the kit! The circuit right is a simplified (owing to lack of space) but shows the principal of how a single inductor is used to provide three band operation. To avoid a second adjustable inductor for 20m, it is easier to parallel a smaller fixed L and then bring the resonant frequency back down with added capacitance from a trimmer. Extra capacitance for 80m is easy and the 150 pF section of the PolyV gives a reasonable tuning range.

I had some comment from a customer who thought the Trull (from which the Cary is closely derived) to be unduly complex compared to his old valved RX regen that seemed to do all this with much less fuss! I had to point out that:-

- An RF stage is needed to prevent radiation
- High Z phones are no longer obtainable
- Customers want it to drive low Z loud speakers
- Plug in inductors for bands are complex
- Single tuning caps need slow motion for wide freq range, or extra band spread capacitor
- Air variables are lovely but very expensive
- Air variables are much harder to mount
- Higher sensitivity is desirable nowadays

Unfortunately what he could do nicely from his well stocked junk box is not the basis of a viable kit design! G3PCJ



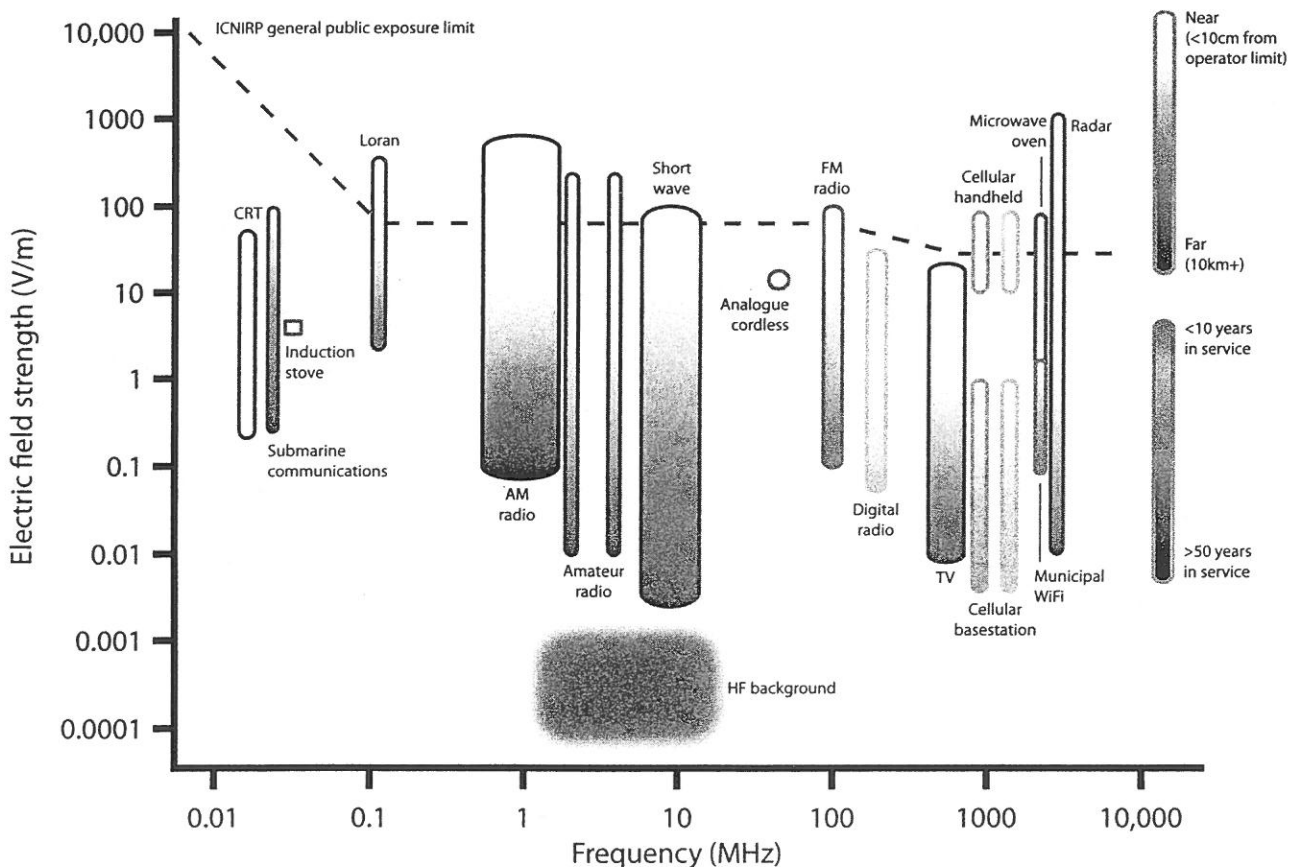
## The RF soup!

This is nothing to do with food but is about exposure to RF radiation. An article in the E & T magazine published by the IET in Sept last year discussed what we are all subjected to in our everyday lives. In recent years there have been two areas of possible concern - low frequency exposure from power lines (especially high voltage ones), and that from mobile phones. Much has been written on both subjects and there are entrenched views on both sides - that there is a problem with long exposure to weak EM fields, or that the only limits to worry about are those due to heating effects in the body. I am no expert and do not offer any opinion! People do get worried by the proximity of mobile base stations to children's playgrounds etc but the field levels from these are much lower than that from a handset transmitting right next to your head! There have been experiments to boil eggs with mobile phones etc but without success! Despite large amounts of money being spent to identify genuine problems, there is very little hard evidence which is able to be replicated in a scientific manner. It is easy to believe that we are being bathed in an increasing soup of RF radiation from Wi-Fi etc but recent studies suggest the RF levels in a metropolitan environment are below 1% of the suggested ICNIRP levels, and are well below that of leakage from a typical microwave oven at a distance of 1m.

The article concludes:-

'Levels of ambient RF have clearly increased since the 20th century began—the few milliwatts per square metre of black body radiation are now supplemented by a variety of sources operating in the microwatt to milliwatt per square metre range, representing a relative increase of five or more orders of magnitude, though from very low levels. But some of these sources have been operating for most of a century - a far longer period in which to recognise any potential health effects than the working lifetime of relative newcomers such as cellular radio and Wi-Fi. That has yet to be reflected in public perception of the risks of RF radiation - if there are any.'

Accompanying the article was a most interesting table (copied below) which confirms my suspicion that the peak power of many MW used by AM broadcasters are some of the highest! Tim



## Snippets!

*Last time's competition* Who was the owner of this useful set of test gear with a very tidy corner in his workshop? The answer was Richard Booth G0TTL and Chris Fleet was the lucky winner. His prize was a transmitter low pass filter kit.



*Magnetism?* A recent letter from David Bud-dery G3OEP says he recently dropped a 4W metal film resistor and was amazed to find that his telescopic pocket magnet attracted it! Was there magnetic material in the end wires? 'When I removed them, the resistor was still magnetic. Where is the magnetic material? Is the metal film magnetic? I seem to have read somewhere that Nickel can be magnetic or is it the substrate that has these properties? I understand that many small permanent magnets, such as those used in low power dynamos or electric motors are often of special material.'

I too have noticed that off-cut wire ends from some resistors or capacitors are magnetic but I suspect this is plain iron. By chance I happened to spot an article in a recent Electronics Weekly which reported a development combining traditional in-organic semiconductors with organic spintronics in a novel device. The polymer is vanadium tetracyanoethylene and is a ferromagnet - just like iron or cobalt. A gallium arsenide LED device was used to observe the spin coupling effects. I am not sure what the potential application of this device might be but I think Nickel and Cobalt are in the same group of the atomic table and hence might share magnetic properties!

*Goobledegook!* Another EW article began '4GLTE or WiMax networks are now just in the process of being deployed and integrating them with existing CDMA and EV-DO networks is a venture into new territory. In the meantime, GSM/WCDMA network operators are deploying HSPA and HSPA+ technologies, and it is becoming difficult to maintain a competitive position with the speeds offered by HSPA networks while staying within the 3GPP2 ecosystem. To tackle this EV-DO Revision B, and extension of the concept of EV-DO Revision A combines multiple Revision A carriers together to offer faster speeds. In a typical three-carrier deployment, Revision B can achieve speeds up to 9.3 mbps on the forward link. ....' Can anybody understand or explain this please?!

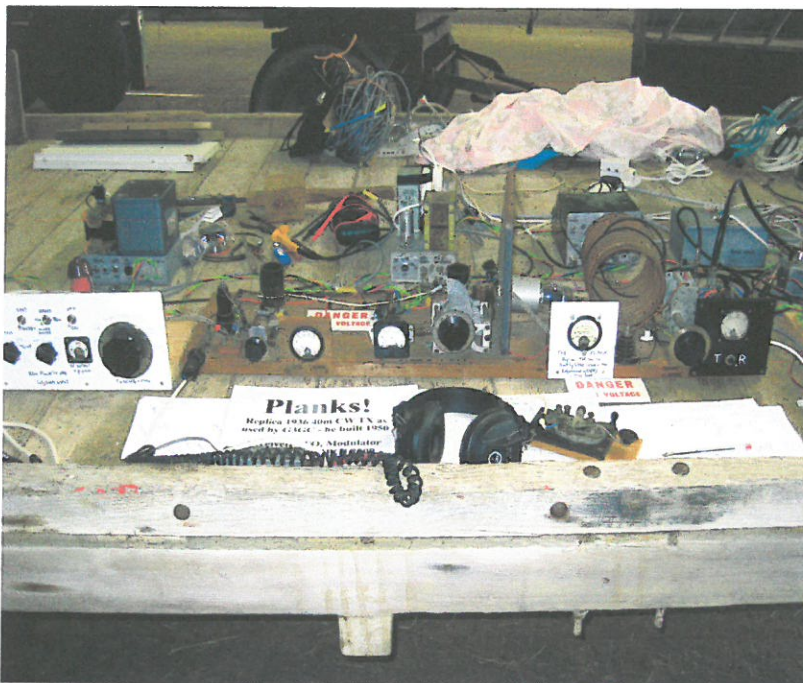
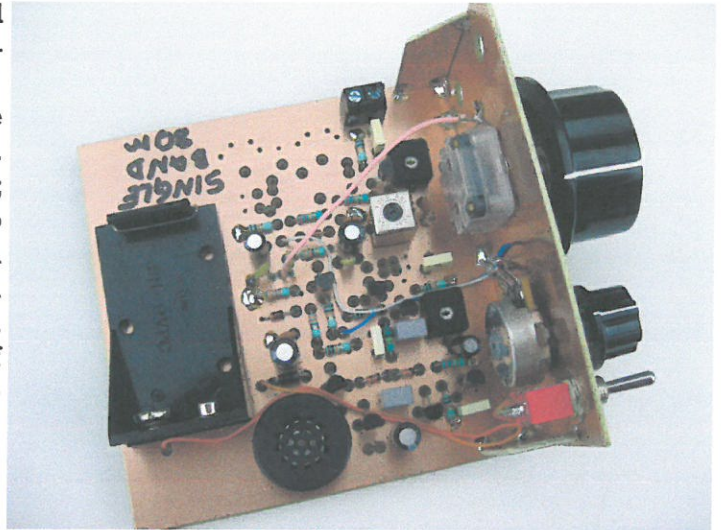
*How loud is it?* I spotted this useful table of Sound Pressure Levels in db recently:-

Jet engine at 3m	140
Threshold of pain	130
Rock Concert	120
Accelerating motorcycle at 5m	110
Pneumatic hammer at 2m	100
Noisy factory	90
Vacuum cleaner	80
Busy traffic	70
Quiet restaurant	50
Residential area at night	40
Empty movie house	30
Rustling of leaves	20
Human breathing at 3m	10
Threshold of audibility (for good ears)	0

So now you know!! Tim G3PCJ PS Where does an S9 + 60 dB signal come in this table?!!

## QRP in the Country 2011

The renowned Bath Buildathon team led by Steve Hartley G0FUW will be running a construction project at QRPiC2011 on July 17<sup>th</sup> 2011 here at the farm - TA10 9NJ. The project will be a basic Cary Regen receiver as photo right. This is a single band RX for MW, 160 or 80m; but parts will be provided for builders to change it to 3 band on 20, 40 & 80m in their own time later. Those wishing to take part should send payment by cheque or Paypal to Walford Electronics. The cost is £40 and construction of the basic RX is expected to take 3 to 4 hours, so there will be time for you to see the other attractions! The closing date for entries is July 4<sup>th</sup>. Places are limited so book early!



The Rev George Dobbs G3RJV will be attending and commenting on a 'Show & Tell' display – please bring along lots of homebrew things for all to see! Rob Mannon G3XFD Editor of PW, the RSGB and other QRP personalities will be there! There will be working demonstrations of the G3GC replica 1930's Plank equipment, vintage wartime gear, several Club displays and individual stalls with a full range of Walford Electronics kits. There will also be a construction clinic for those needing advice or a little help to get something working. There is still plenty of space for more Club stalls or displays – I am very keen for more of them - let me know if you can bring a display of any sort! There is no charge for attendance. Gates open 10 am.

Local food and drink from the farm and the next door brewery will help lighten the day! My wife Janet will lead a short farm walk for those wishing to see the Somerset countryside. The radio event will be held outside but if the necessary will be moved into the farm barns.

## Subscriptions!

I regret it is that time of year again! The next issue of Hot Iron is the first of the membership year and I need to receive your payment of £7 for UK members by Sept 1 2011. Overseas membership costs £9. The price remains unchanged despite the rise in VAT! If you wish to pay via Paypal this is fine, but please add an extra £1 for their fee. All I need is your fee and name/address. To keep it interesting your contributions are essential! You will get bored of me writing it all each time! Any article or note, about your experiences, hints and tips etc. are especially welcome. Allow for about one side of A4 ideally with some sort of picture or diagram. And I am very happy to attempt to answer member's questions. If you don't feel too confident about producing material that is fit for publication I will do my best to turn it into reproducible form! Hope to see you July 17th! Tim G3PCJ